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Q6(c)

Describe the practical applications of DNA technology in the current scenario.

UPSC Civil Services Mains 2023 · Anthropology GS 1 · 15 marks · Applications of Anthropology

12. Applications of Anthropology: Anthropology of sports, Nutritional anthropology, Anthropology in designing of defence and other equipments, Forensic Anthropology, Methods and principles of personal identification and reconstruction, Applied human genetics-Paternity diagnosis, genetic counselling and eugenics, DNA technology in diseases and medicine, serogenetics and cytogenetics in reproductive biology.

Core demand of the question

- Describe the practical applications of DNA technology in the current scenario
- Write at 15-mark length

Revision summary

Jeffreys's DNA fingerprinting and STR databases serve courts and disaster victim identification.

PCR is the workhorse of pathogen testing, including COVID-19.

Medical uses include screening, pharmacogenomics, and early gene editing.

Pääbo's aDNA methods serve prehistory, including Indian Harappan genomes.

GM crops and wildlife barcoding are agrarian and forensic ecological uses.

Consent and over-reading ancestry as race remain anthropological limits.

Introduction

DNA technology reads, copies, and sometimes edits genetic material. Its current practical uses run from courts and clinics to farms, ancestry, and pandemic tests.

Body**Identification and kinship**

- **Alec Jeffreys** introduced DNA fingerprinting in 1984; STR profiles now identify suspects, exonerate the wrongfully accused, and match disaster victims when a reference exists.
- Paternity and immigration kinship tests use the same markers, which forensic anthropology now pairs with bone profiles.
- Databases such as national crime indexes raise liberty questions that anthropology of the state must notice.

Medicine and public health

- **PCR**, associated with **Kary Mullis**, underpins pathogen tests, including the COVID-19 diagnostic wave.
- Carrier screening, prenatal tests, BRCA and other risk panels, and pharmacogenomics tailor drugs to genotype.

- Gene therapy and **CRISPR** editing, after **Doudna** and **Charpentier**, are entering clinics for a few monogenic diseases, with ethics still contested.

Ancestry, ancient DNA, and population study

- **Svante Pääbo**'s ancient DNA methods reconstruct archaic admixture and prehistoric movement, as in Neanderthal genomes and South Asian aDNA from sites such as Rakhigarhi.
- Commercial ancestry tests are popular and often over-interpreted as race.

Food, environment, and industry

- GM crops, DNA barcoding of wildlife for poaching cases, and GMO labelling disputes are applied molecular biology in the agrarian and conservation field.
- Recombinant insulin and vaccines are older industrial applications that still matter.

Anthropological caution

- DNA can name a body and still not name a culture.
- Consent, caste politics of sampling, and the return of results to indigenous groups are part of current practice, not extras.

Flow diagram

DNA technology technology -> Forensic kinship
DNA technology -> Medicine PCR CRISPR
DNA technology -> Ancient DNA technology ancestry
DNA technology -> GM barcoding

Conclusion

DNA technology now identifies persons, diagnoses infection and risk, edits a few diseases, and reconstructs prehistory. The current scenario is laboratory power plus consent and interpretation, not a code that replaces society.

Facts & figures

Alec Jeffreys, 1984

Introduced DNA fingerprinting, the basis of forensic identity testing.

PCR

Polymerase chain reaction, a copying method used in diagnosis, forensics, and research.

CRISPR

A programmable gene-editing system now in early clinical use for some monogenic conditions.

Svante Pääbo

Pioneered ancient DNA recovery, including Neanderthal genomes.

STR profile

A panel of short tandem repeats used to match a person or a close relative in forensic casework.

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